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## Bumblebee Research

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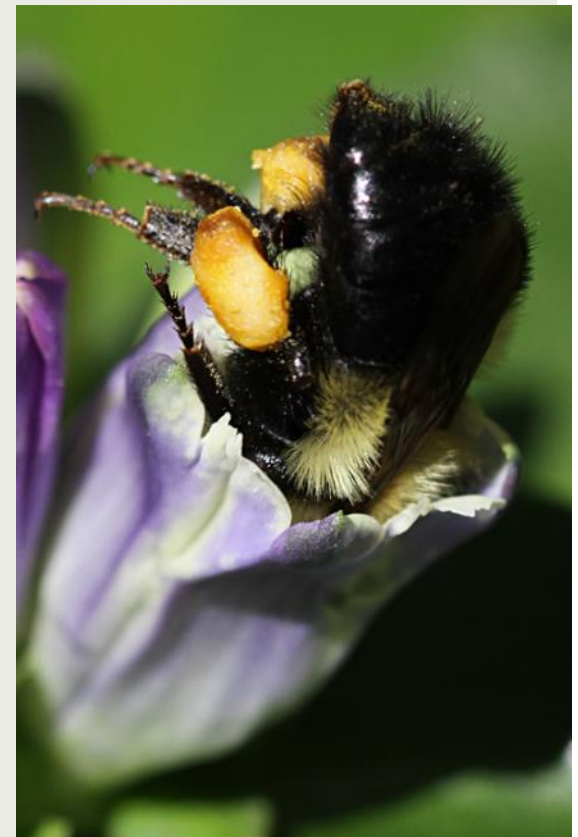
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# Bumblebees

Andrea Couto  
Anne Averill



# Bombus Species in MA



B. impatiens  
Most common  
Koppert



B.  
bimaculatus



B. perplexus



B.  
griseocollis



B. vagans

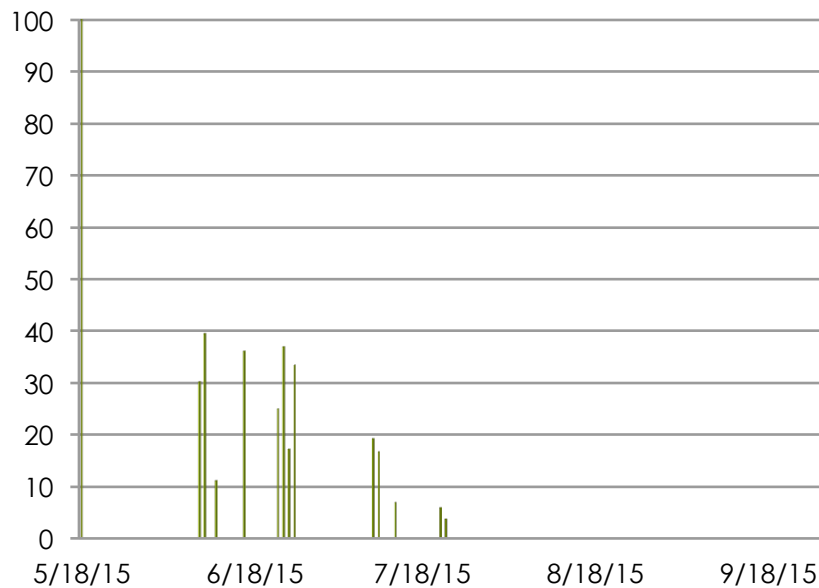


B. fervidus

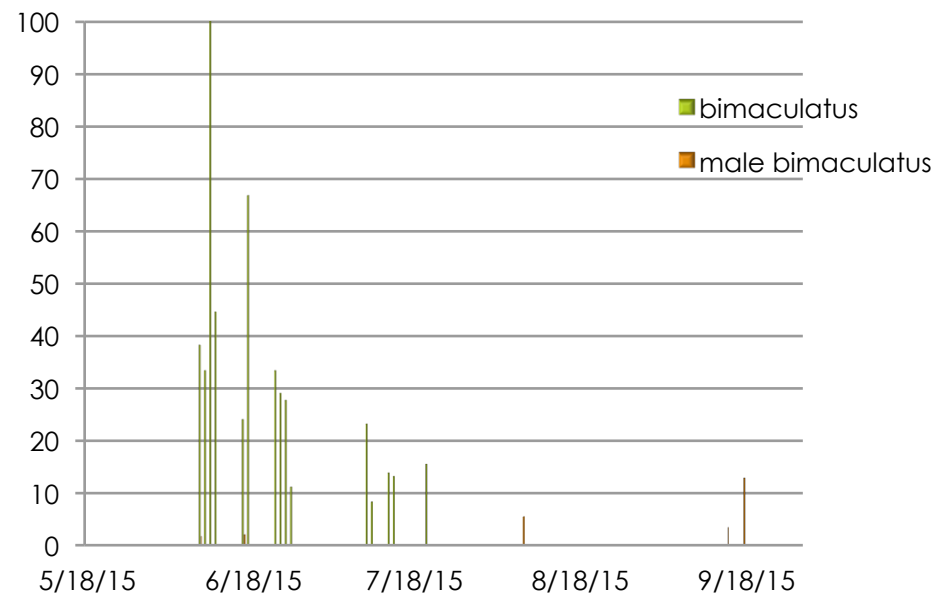
# 2015 Seasonal Activity



Proportion of B. Perplexus By Date



Proportion of B. Bimaculatus by Date

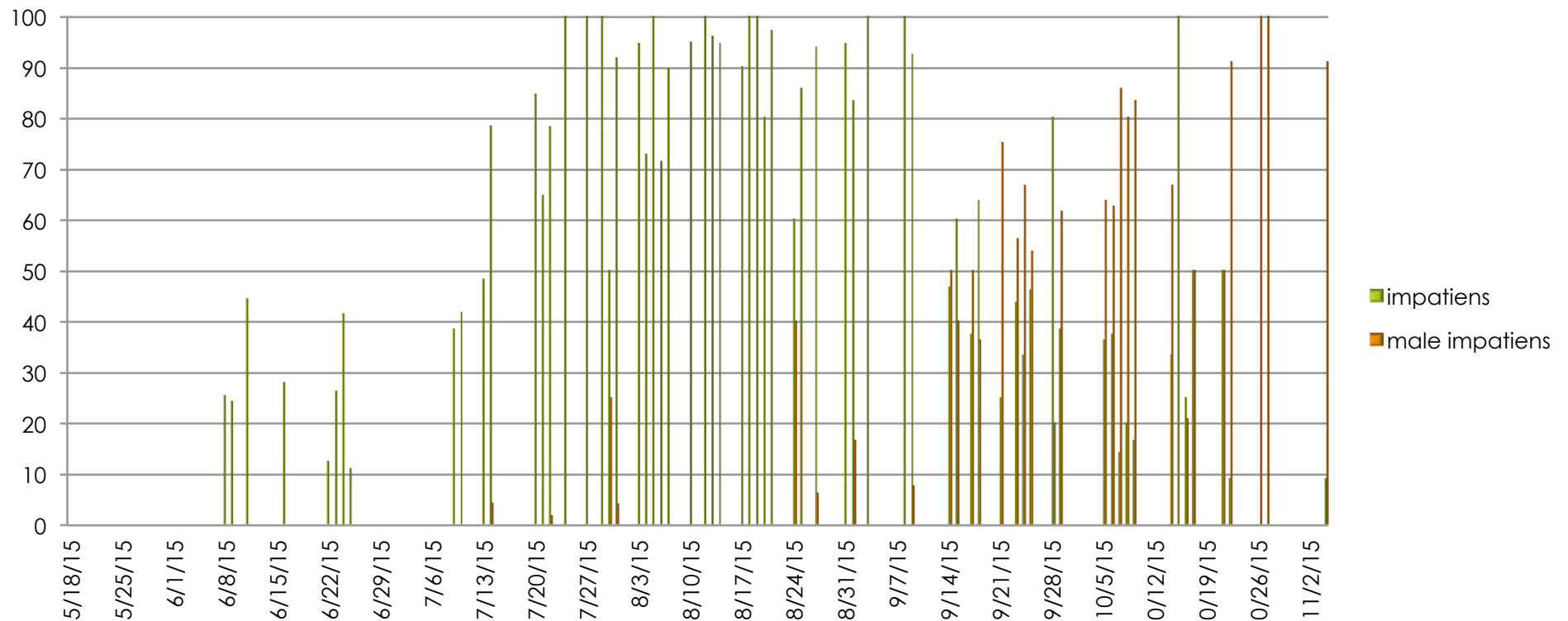




# 2015 Seasonal Activity



**Proportion of B. Impatiens Male and Females by Date**



# Bumblebees are Important Pollinators



- Many flowers are pollinated more effectively with **buzz pollination**- like cranberry.
- Bumblebees visit **2x** as many flowers as H.B. in the same amount of time.
- Bumblebees are adapted to forage under **cold, rainy, and/or cloudy** conditions.



# Bumblebees are Important Pollinators

- The **variation in tongue-length** of bumblebees allows them to pollinate many different flowers with different shapes and sizes.
- Bumblebees are the most abundant native pollinators, as a consequence many plants are adapted primarily and sometimes exclusively for pollination by bumblebees



# Bumblebees and Cranberry Pollination

- Native bee populations are rarely enough to pollinate cranberries and therefore growers are forced to rent honeybee hives.

- BUT

Honeybees do not favor cranberry and will fly long distances to forage elsewhere (1-6km 20km on occasion)



# Bumblebees and Cranberry Pollination

- Bumblebees ARE better pollinators of cranberry in all measures of pollination efficacy and it is much more costly for them to fly long distances.





# Cost of Flying

- It is very costly for bumblebees to fly.  
More flowers = less flying = healthier  
bumblebees
- This means that if you can attract a queen  
to nest near your bog her workers are likely  
to stay there if resources are available.

## Optimal foraging theory



# Want to attract native bees?

- You need a variety of bee-friendly flowers that bloom during different parts of the year
- You can either plant bee friendly flowers, or not mow bee friendly flowers if you see them. Especially when cranberry is not in bloom.



# Bumblebees are in Decline

- The populations of four species have declined up to 96%. Two of these were once abundant in MA
- In 1990 the lab would find 8 species of bumblebee each year. In 2015 we have found only 5 species and the populations of the rarer species are declining dramatically in our sampling.



# Reasons for Decline

- Habitat loss
- Insecticide- Neonicotinoids especially
- Climate change
- Pathogen spillover from commercial colonies
- Invasive species
- Intentional/accidental death

**Could do a whole talk on this slide alone  
And I'm sure you have heard it all before**

# Queens

- PSA: Queens are out as early as MAY!
- We observed 246 queens in May. The MOST common plants we found queens on were Azalea.



Azalea: 34%



Andromeda: 4%



Roses: 6%



Rhod: 22%



Autumn  
Croc: 10%



# Queens

- ❑ Other resources that are good for queens include **flowering trees**
- ❑ We saw BB queens on trees, but they were often out of reach to be included in our study.



Dogwood



Crabapple



Willow

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# What to plant in Spring

To help queen bumblebees plant:

Azaleas

Rhododendrons

Andromeda

Early roses

Honeysuckle

Chokecherry

Dogwood trees

Crabapple trees

Willow trees

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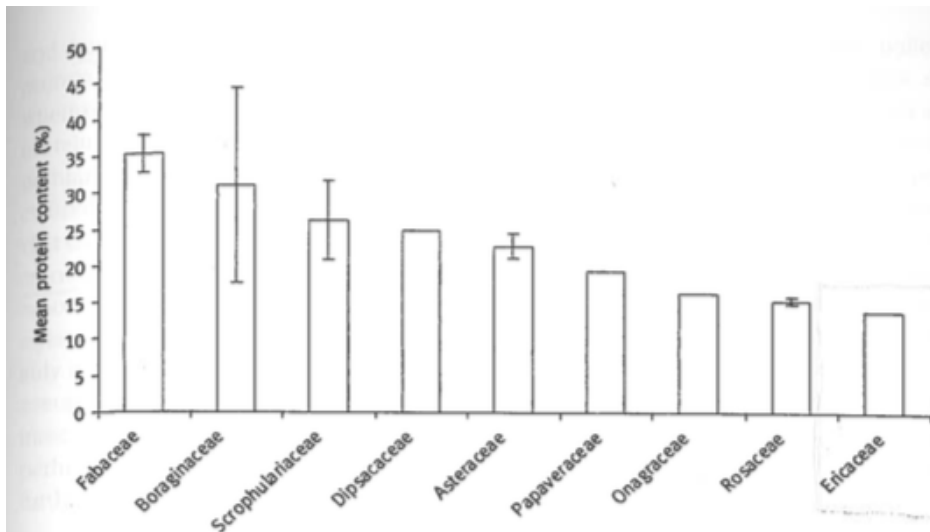
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# Bumblebee Nutrition

- Bumblebees need variety in their diets

# Plant variety acts like a multi-vitamin

Different plants offer bees different **levels of protein content**



**Figure 8.5** Protein content of pollens collected from plants frequently visited by bumblebees for nectar or pollen. From Hanley *et al.* (2008).

**Table 8.2** Mean percentage amino acid composition of proteins in pollen of Fabaceae versus Asteraceae (Hanley *et al.* 2008)

	Asteraceae	Fabaceae
Aspartic acid + Asparagine	9	11
<b>Threonine</b>	<b>4</b>	<b>5</b>
Serine	5	7
Glutamic acid + Glutamine	9	10
Glycine	7	8
Alanine	7	8
<b>Valine</b>	<b>5</b>	<b>7</b>
<b>Methionine</b>	<b>2</b>	<b>2</b>
<b>Isoleucine</b>	<b>4</b>	<b>5</b>
<b>Leucine</b>	<b>6</b>	<b>10</b>
Tyrosine	2	3
<b>Phenylalanine</b>	<b>3</b>	<b>4</b>
Histidine	3	2
<b>Lysine</b>	<b>6</b>	<b>7</b>
Arginine	3	4
Proline	18	5

Essential amino acids are shown in boldface. Note the generally higher levels of essential amino acids in Fabaceae compared to Asteraceae.

Also different **levels** and **kinds of amino acids** in pollen

# Pollen



- Pollen is the main source of protein and essential amino acids for bumblebees.
- Because different plants have different protein content and amino acids– the plants around a colony can impact larval growth.
- It has been demonstrated that pollen is necessary for proper ovarian development in bees. This means plants with high protein content in their pollen is essential for queens.



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## ■ What does all this mean for farmers?

- Plant flowers that bloom in early spring (May) for queens so they get the nutrition they need and also to attract them to nest near your farm.
  - Whenever possible, select plants with high protein content in their pollen and include a variety of plant species in pollinator gardens.
-

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In the spring of 2015 we gathered pollen samples from 80 queens.

So far, we have identified what 24 queens were using this past spring to collect pollen.

The most common plants so far are apple, chokecherry, honeysuckle, and rhododendron.

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Queen Species	Pollen host 1		
<i>bimaculatus</i>	89% <b>Alyssum</b>	<i>impatiens</i>	58% <b>eric. un ID</b>
<i>impatiens</i>	99% <b>apple</b>	<i>bimaculatus</i>	66% <b>holly</b>
<i>perplexus</i>	99% <b>apple</b>	<i>bimaculatus</i>	60% <b>Honeysuckle</b>
<i>impatiens</i>	61% <b>Blackberry</b>	<i>perplexus</i>	93% <b>Honeysuckle</b>
<i>perplexus</i>	97% <b>Bugle</b>	<i>perplexus</i>	94% <b>Japanese quince</b>
<i>impatiens</i>	68% <b>Chokecherry</b>	<i>impatiens</i>	61% <b>mint family</b>
<i>bimaculatus</i>	84% <b>Chokecherry</b>	<i>impatiens</i>	100% <b>Pear</b>
<i>impatiens</i>	73% <b>Chokecherry</b>	<i>bimaculatus</i>	51% <b>Rhododendron</b>
<i>impatiens</i>	94% <b>Chokecherry</b>	<i>griseocollis</i>	97% <b>Rhododendron</b>
<i>perplexus</i>	99% <b>dogwood</b>	<i>vagans</i>	97% <b>Rhododendron</b>
<i>impatiens</i>	99% <b>eric. un ID</b>	<i>bimaculatus</i>	61% <b>rose</b>
		<i>bimaculatus</i>	66% <b>Silverberry</b>
		<i>impatiens</i>	98% <b>violet</b>

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As we identify more pollen samples we will have a better understanding of what queens are using in the spring for pollen collection.

What this means for farmers is the ability for us to provide more comprehensive recommendations to keep our bumblebees healthy.

Stay tuned

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# Moving onto worker bumblebees





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The following slides are what we found bumblebees on this spring and summer in non-agricultural settings

Some of these are alien or invasive, but bumblebees are using them. Invasive plants should be destroyed, but perhaps non-native *non-invasive* plants are doing some good.

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Rhododendron



Dogwood



Crabapple



Japanese Quince



Autumn Olive



Weigela



Clover



Alder Buckthorn



Catmint



Beardtongue



Knapweed



Salvia



Jasione



Mountain Laurel



Jap. Spirea



Hosta



Blackberry



Rose of Sharon

Russian Sage



Beach Rose



Sweet  
Pepperbush



Bird's Foot  
Trefoil



Goldenrod



Beach Plum



Anise Hyssop



Chicory



Cat's Ear



Viburnum



Joe-Pye Weed



Whirling Buttery



Autumn Joy



Heath Aster



Evening  
Primrose



Knotweed



Butter & Eggs



Montauk Daisy



Hydrangea



Honeysuckle



Lilac



Purple Loosestrife



St. John's Wort



Vetch



Yellow Baptisia



Bull Thistle



Coneflower

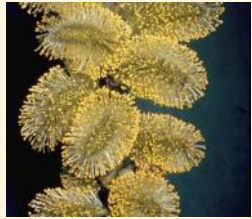


If alien plants make you uneasy the following slides will help you out.

The next few slides contain only **native plants** that we have seen bumblebees on.

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# Native Plants Seen With Bumblebees



Feb Mar  
**Pussy Willow**



Mar Apr May  
**Dogwood**



Mar Apr May Jun  
**American Holly**



Mar Apr May Jun  
**Black Cherry**



Apr May June July  
**Winterberry**



April May  
**Black Willow**

# Native Plants Seen With Bumblebees



Apr May June  
**Beach Plum**



Apr May Jun Jul Aug Sep  
**Purple Coneflower**



May Jun Jul Aug  
**Swamp azalea**



Apr May Jun Jul Aug Sep  
**Common Yarrow**



May Jun Jul  
**Beard Tongue**



May Jun Jul  
**S. arrowwood**



# Native Plants Seen With Bumblebees



May Jun  
**Swamp Rose**



May June  
**Blueberry**



April May Jun Jul  
**Lupine**



May Jun  
**Crabapple**



Jun Jul Aug  
**St. John's Wort**



Jun Jul Aug Sep  
**Meadowsweet**



# Native Plants Seen With Bumblebees



Jun Jul Aug  
**Honeysuckle**



Jun July  
**Threadleaf Coreopsis**



Jun Jul  
**Mountain Laurel**



Jun  
**Blackberry**



Jun Jul Aug  
**Virginia Rose**



Jul Aug  
**Sweet pepperbush**



Jul Aug Sep

**Evening Primrose**



Jun Jul Aug

**Wild Hydrangea**



Jun Jul Aug Sep Oct

**Black-Eyed Susan**



Jul Aug

**Gayfeather**



Jul Aug Sep Oct

**Jewelweed**



Aug Sep Oct

**Joe-Pye Weed**



Aug Sep Oct

**Heath Aster**



Aug Sep Oct

**New England Aster**

# Bumblebee Ecology Recap

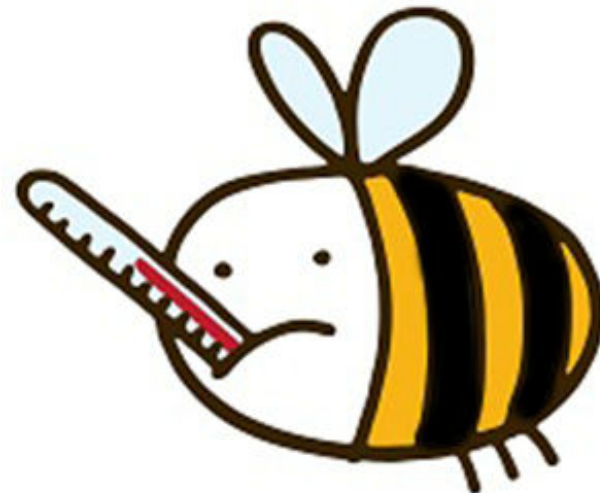
- Bumblebees are ecologically and agriculturally important
- Many species are declining
- One of the most widely implicated causes is habitat loss
- Help bees by planting flowers especially those that bloom in very early spring for nesting queens!



# Pathogens in BumbleBees

STUFF THAT MAKES BEES SICK:

- *Crithidia bombi*
- *Nosema bombi*
- *Apicystis bombi*
- Nematodes
- Conopid Fly Parasitism

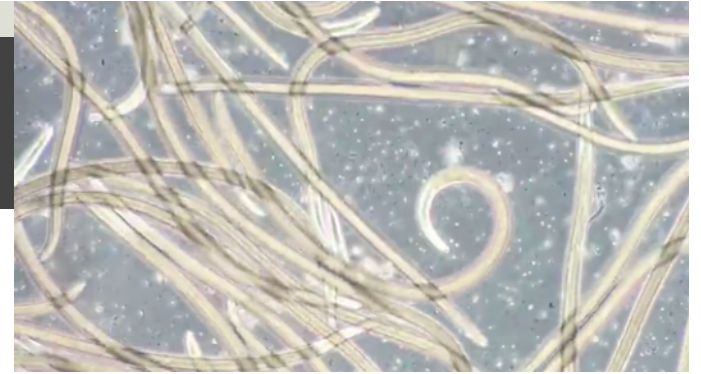


# Pathogens are Linked to Decline

- Declining populations have high infection rates of certain pathogens
- Pathogens could also interact with environmental stressors to aid in the decline of some species
- Pathogen spillover (when introduced populations spread disease) has been implicated in the decline of some species of bumblebee, like *B. dahlbomii* in Argentina.



# Nematodes in Queens



- Exclusively infects overwintering queen bumblebees.
- Infection rates vary from 12-50%
- Instead of looking for a nest and starting a new colony, infected females will look for overwintering sites and live there until they die and the nematodes are deposited in the soil to infect the next queen.



# Conopid Fly

- Infects 20-30%%  
Peak of 70%
- The conopid fly injects her egg into the bee's abdomen.
- The egg hatches inside the bee and eats fluid and bee gut as it grows.
- When it has finished eating all the bee gut the larva pupates 10-12 days.



# Parasitic Larvae in Queens

Very little is known of these parasitic wasps

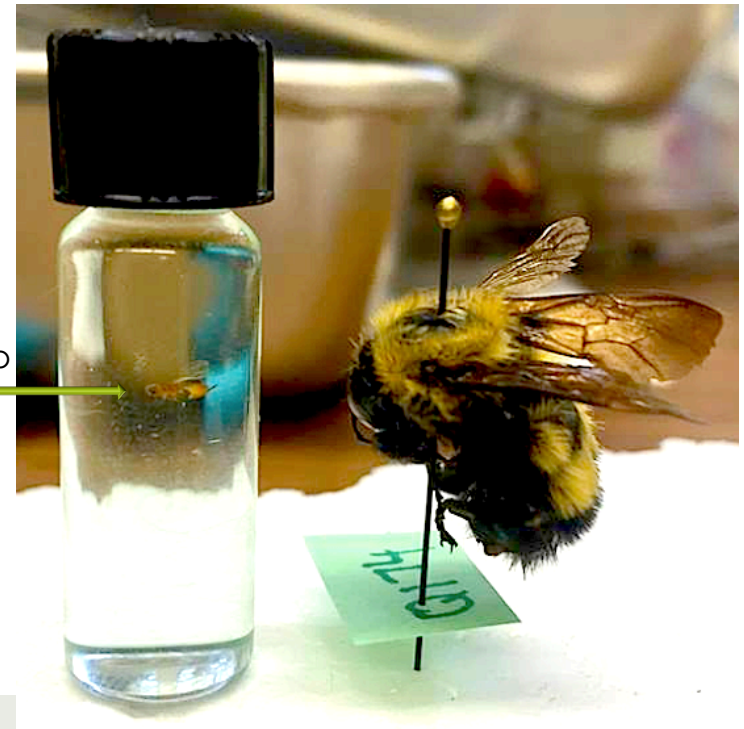
We found that it infected 3.3% the queens we collected

These tiny wasps laid up to 152 eggs inside the queen's abdomen.

Larvae



Parasitic Wasp





# Percent of Workers Infected 2015



P



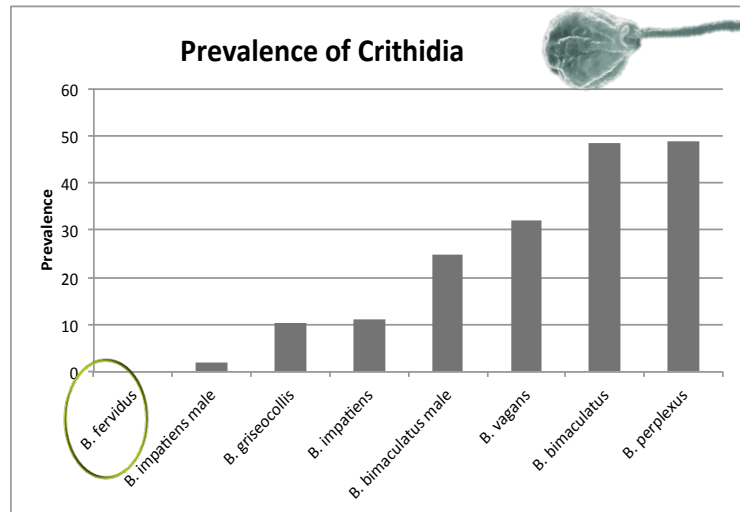
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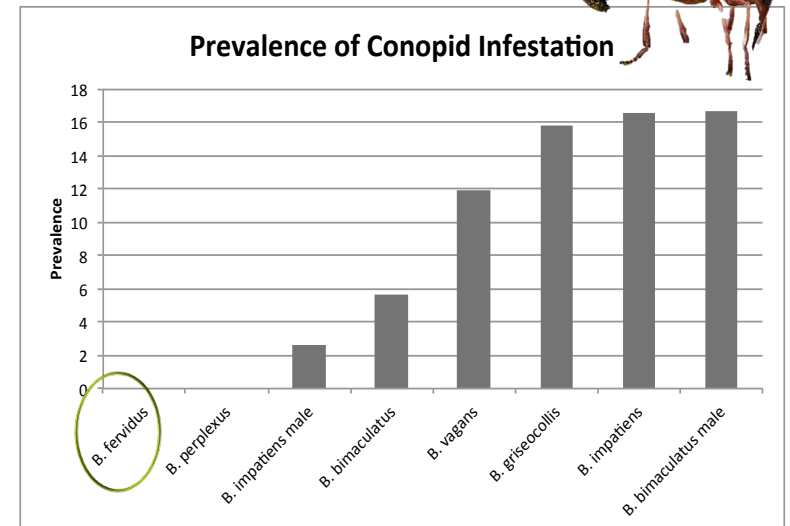
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B



Currently these parasites are not linked to decline in bumblebees

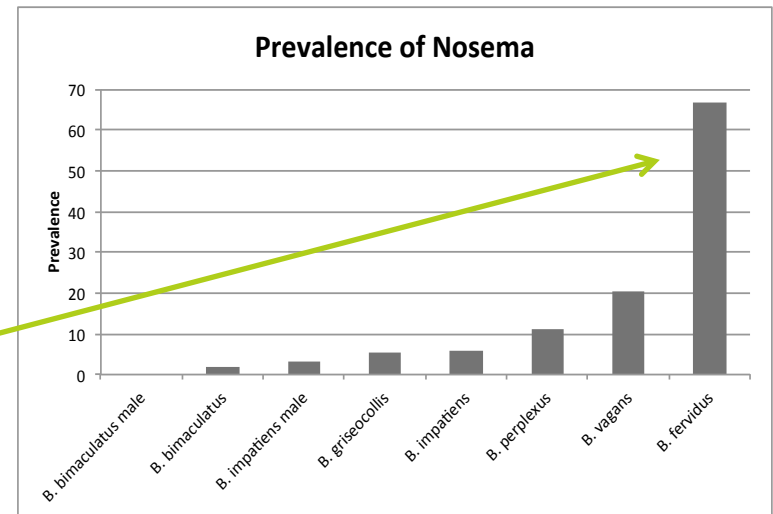


Low sample sizes for **Bimaculatus male 12** and **Fervidus 3** but could indicate a trend

# Percent of Workers Infected 2015

Nosema is more prevalent in declining species of bumblebees

Fervidus has already been deemed a declining species. We can see this relationship in our data.



Low sample sizes for **Bimaculatus male 12** and **Fervidus 3** but could indicate a trend

# Questions?

Special thanks to Kim Skyrme, Sam Scott, Emily Brown, Ally Cinq-Mars, and Valovio Costa for enthusiastically helping us contribute to the understanding of bumblebees.

